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2019

Väätäinen , S , Soini , E J , Arvonen , S , Suojanen , L & Pietiläinen , K 2019 , ' Potential direct secondary care cost benefits of HealthyWeightHub - Virtual Hospital 2.0 digital lifestyle intervention ' , Finnish Journal of eHealth and eWelfare , vol. 11 , no. 4 , pp. 342-356 . <https://doi.org/10.23996/fjhw.8>

<http://hdl.handle.net/10138/311801>
<https://doi.org/10.23996/fjhw.82457>

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Potential direct secondary care cost benefits of HealthyWeightHub – Virtual Hospital 2.0 digital lifestyle intervention

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Abstract

HealthyWeightHub (HWH) is a 12-month coaching and education service designed to help patients with obesity make permanent life changes, launched and expanded gradually in Helsinki University Hospital (HUS) Healthvillage since 2016.

We examined the direct secondary care cost benefits of HWH, measured with potential capacity freed (PCF) compared to conventional group coaching (CGC). Costs included health care, patient co-payments and travelling expenses. First, we evaluated the PCF actualized in the first two years from 2016 to 2018 in the HUS Specific Catchment Area (HUS ERVA). Then, we predicted the PCF at Finnish national level, if HWH was implemented gradually over the five years from 2018 to 2022, aimed at treating 1 % of adults with obesity annually in 2022.

HWH's actualized PCF was €2.69 million compared to CGC in the first two years in HUS ERVA. If the patients who received CGC had been treated with HWH instead, total PCF could have been €3.71 million. At Finnish national level, providing CGC to 1 % of adults with obesity was predicted to cost €28.0 million (€5.08 per capita) annually in 2022. With HWH predicted cost was €7.31 million (€1.33 per capita), meaning an annual PCF of €20.7 million (€3.75 per capita) in 2022 and cumulative five-year PCF of €57.5 million (€10.43 per capita). Compared to CGC, HWH is estimated to enable treatment of approximately 3.8-times more patients with obesity at the same cost.

HWH can be more affordable than CGC and a potentially efficient tool to combat the obesity epidemic. Future evaluations should examine HWH's effectiveness and impact on the indirect costs associated with weight loss and long-term illness.

Keywords: digitalization, eHealth, cost, efficiency, obesity, prevention

Introduction

Obesity and obesity-related morbidities are an enormous public health problem in Finland and world-wide. Latest estimates indicate that approximately 68 % and 58 % of the adult Finnish men and women are over-

weight (body mass index, BMI ≥ 25 kg/m²), and 24 % and 26 % have obesity (BMI ≥ 30 kg/m²), respectively [1,2]. That is, there are approximately 2.8 million overweight and 1.1 million individuals with obesity among the 4.5 million adult Finns.

Obesity increases the risk of many conditions and diseases, such as, type 2 diabetes, hyperglycemia, hypertension, dyslipidemia, fatty liver, sleep apnea, cardiovascular disease, arthrosis and asthma, all posing a significant threat to patients' life expectancy and quality of life [2]. Consequently, the treatment of obesity aims at prevention and management of obesity-associated conditions. Moreover, modern approaches are based on behavioral changes that modify daily lifestyle and require comprehensive and sufficiently long patient-centered intervention to facilitate long-term change in individual's behavior [3,4].

However, provision of sufficiently comprehensive treatment in person on a large scale is challenging, given the resource and budget restrictions of the real-life health care systems. To address this, web-based weight loss and lifestyle interventions have been studied rather extensively to find more efficient ways to deliver interventions (e.g., [5-11]). In line with the modern eHealth developments, Helsinki University Hospital District (HUS) launched the Healthvillage (Terveysylä.fi) online portal in the spring of 2016. Alongside the Healthvillage platform, a new web-based treatment program for obesity, HealthyWeightHub (HWH), was first established in October 2016. HWH is a 12-month long virtual coaching service, designed to help patients to make permanent behavioral changes. Currently, HWH is available nationally free of cost for all Finnish citizens with a BMI > 25 kg/m², based on referral from any licensed physician. Although HWH collects relevant health outcome data, it is not available at this time.

While the observed effects of various previous web-based weight loss and lifestyle programs implemented in different settings have ranged from poor to excellent [5-11], previous literature does suggest that modern, digitalized and comprehensive approaches can have the potential to improve availability and cost-efficiency of weight loss management [6-8,12].

Previously, digitalized secondary care services with Virtual Hospital 2.0 were modelled to have a substantial potential to free health care capacity at aggregate Finnish level [12]. In addition, a recent study demonstrated that web-based health behavior change support can be

efficacious in achieving and maintaining weight loss up to 24 months in the Finnish setting, independent of whether the web-based support is given in addition face-to-face sessions or not [8]. However, no real-world data (RWD) on the effectiveness, utilization or costs of online programs using novel interactive technologies including virtual coaching in treatment of obesity in the Finnish setting exist. While previous studies have indicated that web-based lifestyle intervention can be efficacious [7,8], and also more affordable than face-to-face programs [6,7], these findings are not readily transferable to other health care settings or web-based interventions, with different contents or implementation methods, such as HWH.

Thus, in the present study our aim was to:

1. *Evaluate* the already actualized cost benefits of HWH at HUS Specific Catchment Area (HUS ERVA) based on retrospective RWD, and
2. *Predict* potential cost-benefits of nationwide implementation of HWH at Finnish national level.

Materials and methods

This cost-benefit analysis followed the health technology assessment (HTA) pathway for the suitable and applicable parts. Thus, PICOSTEPS principle (Patients – Intervention – Comparator – Outcome – Setting – Time – Effects – Perspective – Sensitivity) structural analysis and reporting principle was applied, as PICOSTEPS reports the content of health economic evaluations such as cost-effectiveness, cost-utility, cost-benefit, cost minimization, value of information, risk-benefit or RWD in the order of importance [13-16]. PICOSTEPS covers the content of the official cost-effectiveness analysis guidelines by the Finnish Pharmaceuticals Pricing Board [17] and is line with the HTA recommendations by the Finnish Medicines Agency [18] and Finnish Medical Society Duodecim [19].

Patients

Analyses considered the patients receiving intervention for obesity in the 1) the HUS Specific Catchment Area (HUS ERVA) and 2) Finland national level generally. Between October 2016 and October 2018, a total of 1,518 patients received HWH at HUS ERVA (83, 492 and 943 patients in years 2016, 2017 and 2018, respectively). A total of 577 patients received conventional group coaching (CGC) between January 2016 and October 2018 (243, 194 and 140 patients in 2016, 2017 and 2018, respectively).

Based on the FinTerveys 2017 study, approximately 24.4 % and 26.0% of adult Finnish men and women aged 18 years or older have obesity (BMI at least 30 kg/m²), respectively [1]. With the population of 2.128 million adult men and 2.278 million adult women [20], approximately 1,125 million adult Finns have obesity.

For the predictive national level analyses, a minor-to-modest treatment goal was assumed: treat 1 % of these adults with obesity (i.e. 11,250) annually by the year 2022. This target corresponds well to historical average annual increase in the number of individuals with obesity aged 20 to 64 years in Finland between 1980 and 2018 [21]. In essence, the approximate analytical target was set to stop the number of Finns with obesity increasing by year 2022.

Intervention and Comparator

The intervention, HWH, is a mobile, structured and automated 12-month intervention that encompasses weekly training sessions and a wide spectrum of different approaches (diet, physical activity, sleep, psychology, coping for stress, health). With approximately 200 alternatives, the participants can also freely choose sessions to best match their individual taste. Around 60 training sessions are on video or audio in the HWH, to widen the range of treatment modalities and to increase motivation. The participants can submit weight and diet logs to the HWH, for which they receive feedback. In addition to the automated, interactive pro-

gram, HWH includes a virtual personal coach allocated to each patient.

The HWH uses the five technical key components that have been shown to significantly decrease weight in guided internet-delivered weight loss programs: 1) self-monitoring, 2) counsellor feedback and communication, 3) group support, and the use of 4) structured and 5) individually tailored programs [5]. The HWH has a strong psychological framework – acceptance and commitment therapy (ACT) – to increase mindfulness and psychological flexibility in lifestyle change [22]. ACT is a so-called ‘new wave’ of cognitive behavioral therapy; it supports flexible decisions in everyday life that – in contrast to rigid rules – have a long-lasting effect [23,24].

HWH was compared to conventional group coaching (CGC) provided in the secondary health care. Finnish Current Care Guidelines acknowledge that CGC usually comprises 5 to 15 group sessions of dietetic and/or psychological group counselling aimed at examining patient’s situation and promoting change, controlling eating habits, restricting caloric intake and securing sufficient nutrition from diet, and increasing physical activity [2]. The group sizes and methods of implementing CGC vary regionally and by provider.

Outcomes

The primary cost-benefit outcome was the estimated and predicted potential capacity freed (PCF) at the HUS ERVA and Finnish national level, allowed by the HWH, respectively. Health care market mechanisms can fail, causing imbalance between demand and supply and health care can be luxury good demanded in increasing amounts (see e.g. [25]), for multiple reasons (see e.g. [26]). Thus, cost-savings achieved with more efficient service provision may not translate into total budgetary savings because the saved monies are usually reallocated to meet the demand or need remaining elsewhere. In addition, the saved monies may produce more health benefits in their reallocation – especially when the production technology changes [27]. This in mind, PCF denotes the monetary potential for allocating health

care and health care related resources to meet the demand, need or health benefit production elsewhere. PCF can crudely be considered as cost-savings available for reallocation, for instance, treating more patients within the same budgetary limitations.

In present analyses PCF was estimated at year 2017 real values (euros). Per capita PCF were estimated in Finnish national level analyses using 2018 year-end total Finnish population of 5,517,919 individuals [20]. No discounting or mid-year estimates were applied.

Settings and Time

Cost-benefit analyses were conducted in two settings and time horizons. First, the actualized cost benefits of using HWH instead of CGC at HUS ERVA level during the first two years of HWH implementation were evaluated. Analysis was carried out in retrospective setting utilizing counterfactual estimation, evaluating scenario where patients treated with HWH in a two-year period between October 2016 and October 2018 would have been treated with CGC instead. In addition, it was also counterfactually evaluated how much additional PCF could have been gained, if patients treated with CGC from January 2016 to October 2018 had been treated with HWH instead.

Second, a predictive analysis examining the PCF by implementation of HWH at Finnish national level was modelled over a 5-year time horizon from year 2018 to 2022. Analysis was carried out in annual calculations and was based on an expectation that nationwide HWH implementation, with the goal of treating 1% of the Finns with obesity annually by 2022, was initiated in the beginning of 2018 and completed gradually in five years.

Effects

HWH cost is fixed: The service is free for the patient, but the hospital district referring the patient for HWH is billed €650 per patient for the 12-month intervention. The HWH does not incur any patient fees or travelling expenses.

Expected resource use (i.e. secondary care treatment, patient fees, travelling) and unit costs of CGC were based on the Finnish RWD and expert information. On average, patients in CGC were modelled to attend 11.8 group coaching sessions, costing a total of €2,070 per patient. In addition, each visit was associated with a patient fee and travelling expense.

Year 2018 HUS patient fees were used for series visits (€11.40 per visit) for the HUS ERVA level analysis and estimated average national fee in Finland (€10.96 per visit) for the Finnish national level analysis. The average national level patient fee was estimated by weighting the specific catchment area patient fees for series visits (ranging €9.00 to €11.40) with the number of inhabitants living in each area (ranging from 0.741 to 2.15 million in 31.12.2016 [28]).

Travelling expenses were based on statistics of reimbursed travels [29, 30] and local bus tariffs. Depending on the specific catchment area, approximately 9.8 % to 19.4 % of the trips were reimbursed by the Social Insurance Institute in 2015 [29]. The average cost of reimbursed two-way travel was estimated as the twice the average reimbursed one-way trip cost in the specific catchment area (ranging from €66.83 to €92.91 in year 2017 [30]). All non-reimbursed travels were modelled conservatively (i.e. not benefitting HWH), and for simplicity, to incur two cheapest local bus tickets in the specific catchment area main cities (ranging from €2.90 to €3.30 per ticket). The weighted averages of reimbursed and non-reimbursed travel costs were utilized in the analyses.

For HUS ERVA the average travelling expense was estimated at €18.29 per visit. The average national level travelling expense of €24.58 per visit were estimated by weighting the estimated specific catchment area travelling costs (estimated at €18.29, €21.52, €23.87, €30.00 and 41.30 € per visit in Helsinki, Turku, Tampere, Kuopio and Oulu specific catchment areas, respectively) with the number of inhabitants in each area.

Perspective

Based on the Finnish health economic evaluation guideline [17] and HTA recommendations [18,19], analyses were conducted from the perspective of secondary health care payer covering only direct secondary care costs and travelling expenses, which were expected to be a significant driver of direct cost benefits [31,32] along with the secondary care costs. Although e.g. primary care costs are generally important to account for [33], direct primary care and social care costs, as well as long-term secondary care costs, were excluded due to lack of data.

Moreover, while very important in wider societal perspectives [32,34], indirect costs, such as sickness allowances, pensions, absenteeism, presenteeism, education, unemployment, household chores, taxes and other income transfers, were excluded, as the payer perspective was used. Neither were any potential benefits in reducing costs due to long-term morbidity associated with the obesity analyzed. Thus, in essence, no impact was assumed to other than short-to-moderate term secondary health care related budgets, constituting quite a conservative analysis setting for HWH.

Sensitivity analyses

As the analyses examining the actualized PCF in 2016 to 2018 were based on RWD from HUS ERVA, no sensitivity analyses were conducted for these analyses.

For the predictive analyses examining the potential nationwide implementation of HWH, deterministic sensitivity analyses were carried out examining impact of 20 % decrease or increase in the 1) average number of visits (and costs) associated with the CGC and 2) number of patients treated in 2022.

Results

Cost-benefits at the HUS ERVA area in 2016 to 2018Q3

HWH's actualized PCF was €2.69 million over the first two years between October 2016 and October 2018 at the HUS ERVA level, compared to a scenario where patients treated with HWH would have received CGC instead of HWH (Figure 1). Care was the largest driver of PCF (€2.16 million; 80 % of total PCF), followed by travel expenses (€0.33 million; 12 %) and patient fees (€0.20 million; 8 %).

Furthermore, if all patients who received CGC between January 2016 and October 2018 had been treated with HWH instead of CGC, additional €1.02 million of capacity could have been freed at the HUS ERVA level (Figure 2). Approximately €0.82 million could have been freed from care, €0.12 million from travelling expenses and from €0.08 million from patient fees. Consequently, the total PCF at the HUS ERVA level could have been approximately €3.71 million already during the first two years of HWH being available.

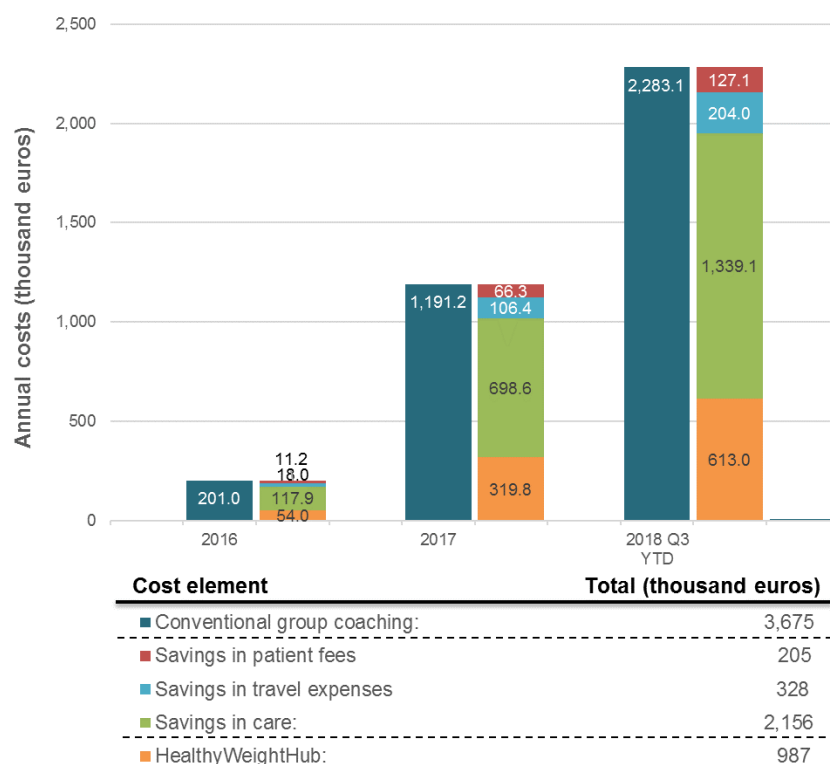


Figure 1. Estimated actualized potential capacity freed with the HealthyWeightHub at HUS ERVA in two years between October 2016 and October 2018.

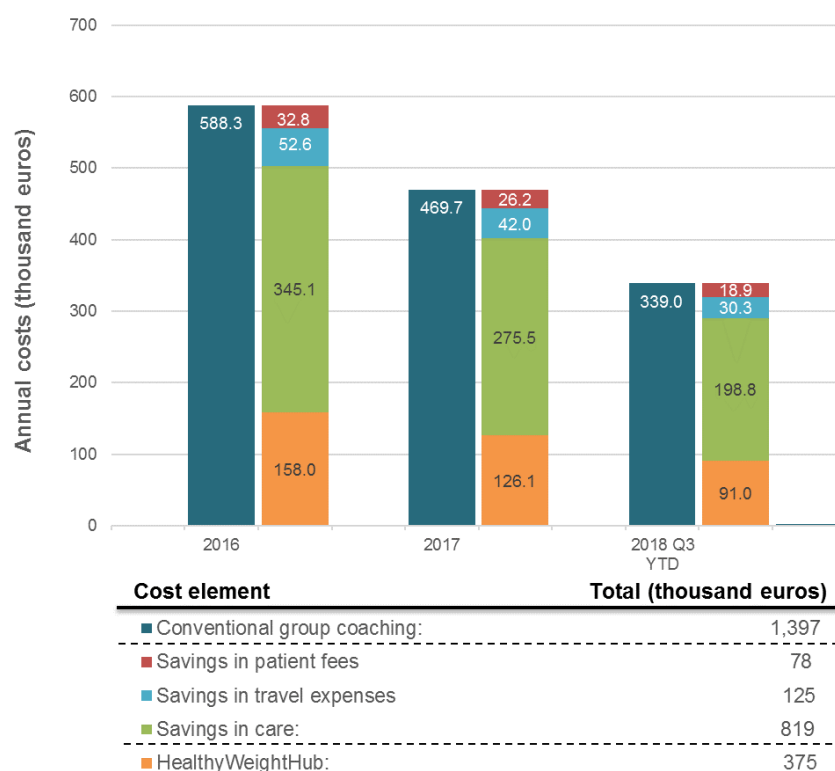


Figure 2. Potential capacity that could have been freed at HUS ERVA, if the patients receiving conventional group coaching between January 2016 and October 2018 had received HealthyWeightHub intervention instead.

Predicted cost-benefits at the Finnish national level over five years

At the Finnish national level, treating 1 % of the adults with obesity with CGC was estimated to cost approximately €28.0 million (€5.08 per capita, 2018 year-end Finnish population) in 2022 (Figure 3). In comparison, treating the same number of patients with HWH was estimated to cost only €7.31 million (€1.33 per capita; 26 % of the CGC cost), resulting in annual PCF of €20.7 million (€3.75 per capita) in 2022. At the Finnish national level, PCF from travelling expenses accounted for 16 % of the total estimated PCF.

The cumulative five-year PCF due to treating 1 % of the adults with obesity by 2022 with HWH would be €57.5 million (€10.43 per capita) at the Finnish national level compared to CGC. Approximately €44.4 million (€8.05 per capita; 77 %) of PCF would come from care. Overall, approximately 3.8 times more patients could be treated with HWH than possible with the CGC in a fixed budget situation.

The sensitivity analyses with 20% lower and higher CGC costs and visits demonstrated that the estimated annual cost of CGC in 2022 varied between €22.4 and €33.6 million (€4.06 and €6.09 per capita), with the respective estimated annual PCF achieved with HWH varying from €15.1 (67 % of total CGC costs) to €26.3 (78 %) million in 2022 (€2.74 to €4.77 per capita) and total 5-year PCF varying from €42.0 to €73.1 million (€7.61 to €13.25 per capita; Figure 4).

Treating 20 % less or 20 % more patients by 2022 would result in annual cost of HWH of €5.85 to €8.78 million (€1.06 and €4.06 per capita) in 2022, respectively (Figure 5). The consequent estimated annual PCF in 2022 and total estimated 5-year PCF in 2018-2022 varied from €16.6 to €24.8 million (€3.00 to €4.50 per capita) and from €47.2 to €67.9 million (€8.55 to €12.30 per capita), respectively, but had no impact on the relative PCF.

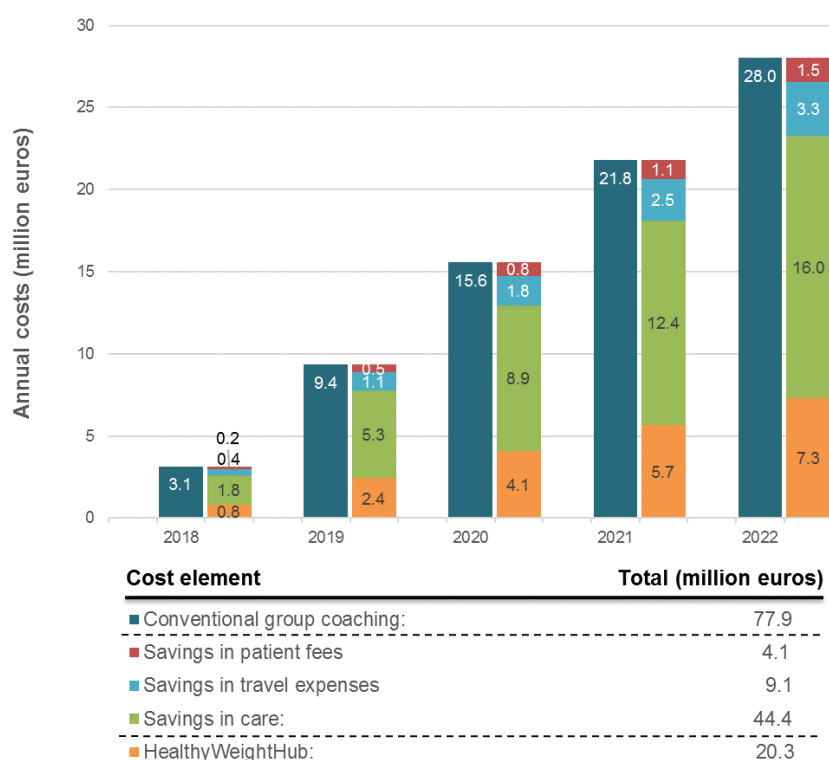


Figure 3. Predicted potential capacity freed at the Finnish national level, if the HealthyWeightHub was implemented gradually over five years between 2018 and 2022, and the goal was set to treat 11,250 patients with obesity annually in the year 2022.

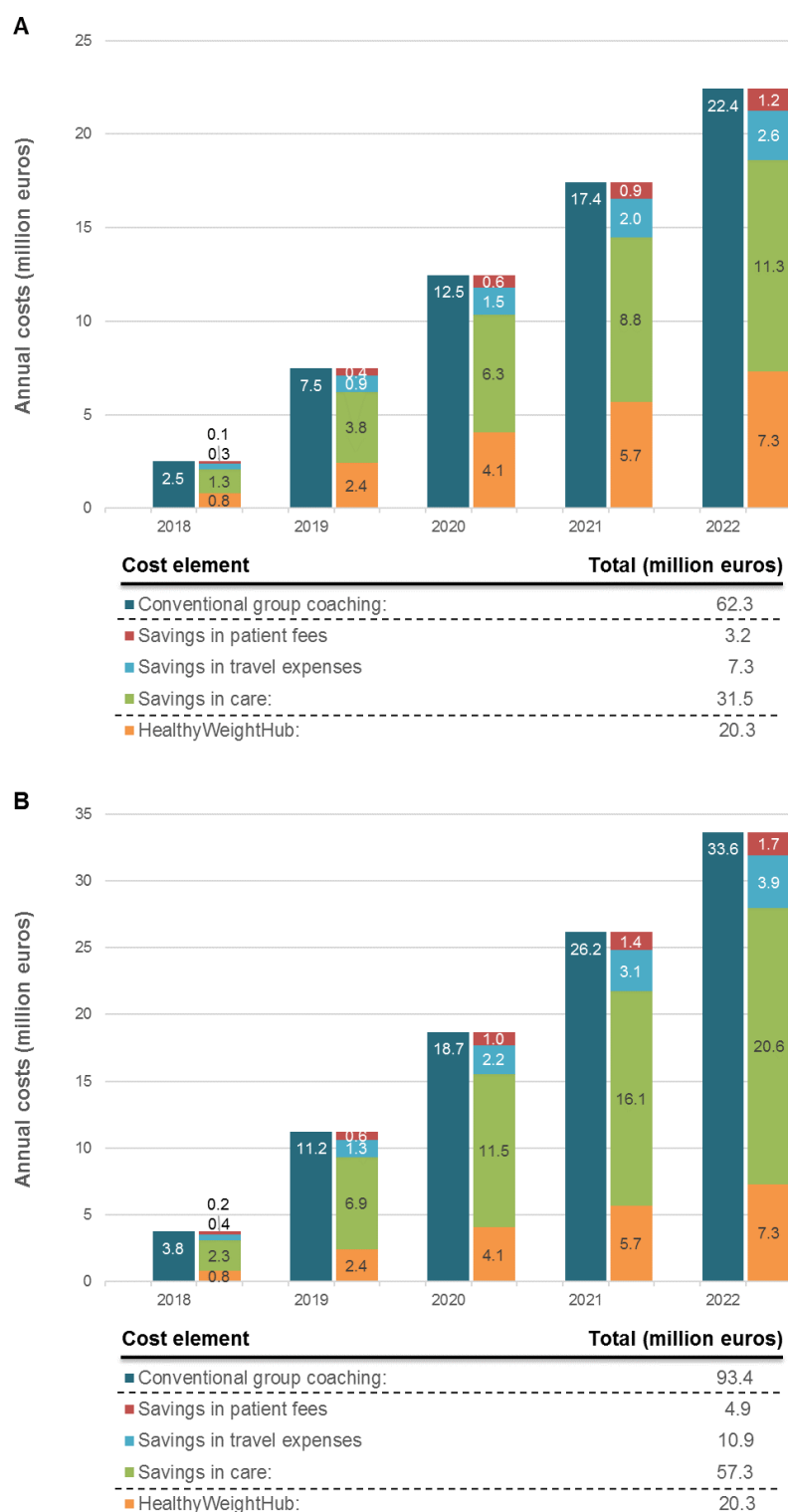


Figure 4. Sensitivity analyses for the predicted potential capacity freed at the Finnish national level, if the HealthyWeightHub was implemented gradually over five years between 2018 and 2022, and the goal was set to treat 11,250 patients with obesity annually in the year 2022. A) 20 % lower and B) 20 % higher conventional group coaching visits and costs.

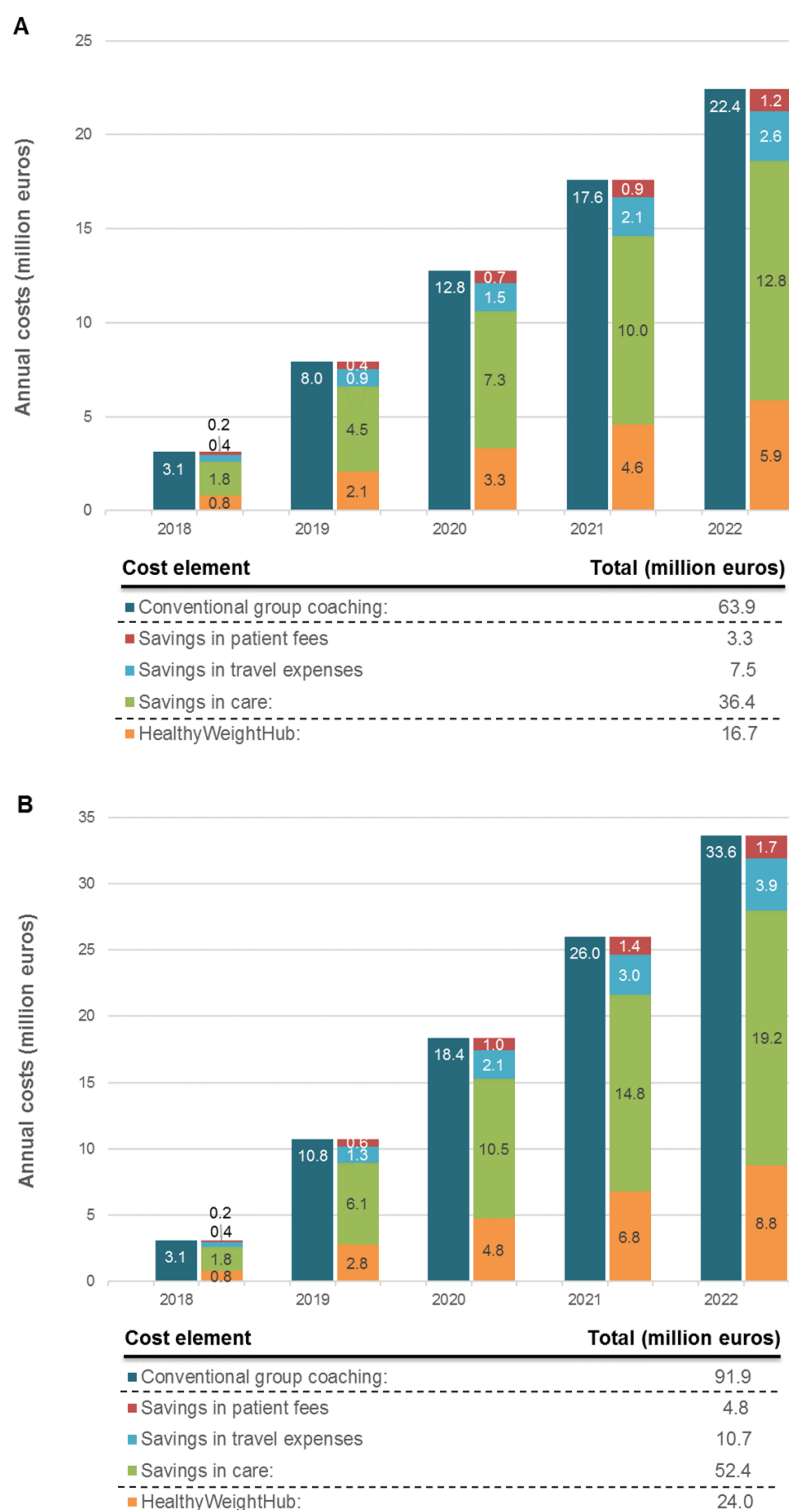


Figure 5. Sensitivity analyses for the predicted capacity freed, if the HealthyWeightHub was implemented gradually over five years between 2018 and 2022, and the goal was set to treating A) 9,000 and B) 13,500 patients with obesity annually in the year 2022.

Discussion

The present cost-benefit study examined the actualized and predicted potential capacity freed (PCF) when substituting the conventional group coaching (CGC) with the modern, comprehensive digitalized program, HealthyWeightHub (HWH), in the treatment of patients with obesity in HUS Specific Catchment Area (HUS ERVA) and at the Finnish national level, respectively. Assessment was conducted from the payer perspective, with the underlying question being whether the payer (e.g. municipality) should arrange HWH or CGC. From payer's perspective, development, investment, production, maintenance and many other types of producer costs are all included in the price accepted by the payer. Thus, these costs were not considered explicitly here. Explicit assessment of these costs could be relevant for internal accounting, a producer perspective analysis or wide societal perspective assessing different drivers of costs. However, in the case these costs were explicitly included, they would need to be included for both HWH and CGC.

Overall, data indicates that HWH's actualized PCF was cumulatively €2.69 million already in the first two years from October 2016 to October 2018 in HUS ERVA. HWH would have had resulted to the additional estimated PCF of €1.02 million, had CGC been replaced completely with HWH in January 2016 and onwards. At the Finnish national level, the predicted PCF was also considerable, when the set target was to approximately stop the increase in the number of adults with obesity in Finland by 2022. The annual PCF in 2022 was predicted at €20.7 million (€3.75 per capita) or 74 % of the predicted annual CGC costs. Thus, approximately 3.8 times more patients could be treated with the same costs, if HWH is used instead of the CGC in a fixed budget setting. Given these results, the HWH is seen as a very potential solution to combat the increasing obesity epidemic in Finland, and perhaps in other settings with obesity challenges.

Only a few earlier studies have assessed the health economic aspects of eHealth services in Finland, and no published study has examined cost benefits of comprehensive web-based treatment programs for patients

with obesity in the Finnish setting. In a dynamic modelling-based cost-benefit assessment at total aggregate Finnish national level, the five-year cumulative PCF with Virtual Hospital 2.0 related to the secondary care was estimated to be €1.3 billion [12]. While studies examining other web-based weight loss interventions in health care settings outside Finland are not easily transferable to Finnish setting, nor applicable in evaluation of cost benefits of HWH, the previously published foreign cost-effectiveness studies [6,7] give encouraging support to our finding that HWH can be affordable alternative to CGC.

In a 24-week study of 49 Hong Kong patients examining a web-based intervention much less comprehensive than HWH, Chung et al. found that, compared to 12 weekly face-to-face private counselling sessions with dietary log book, a program of three 2-hour seminars with interactive web-based dietary records and dietitian feedback resulted in significantly larger weight (10.8 kg vs 4.7 kg) and fat loss (7.8 kg vs 3.0 kg) at week 24 at affordable additional total direct cost (US\$ 442.46 vs US\$ 270.75) [6]. Large proportion of additional costs incurred from the evaluation of patients' dietary records.

In a larger 12-month study conducted in the United Kingdom, Little et al. found that a web intervention with remote support resulted in similar weight loss outcomes as a web-intervention with the face-to-face nurse support [7]. Compared to common control group with evidence-based advice and simple materials only, web interventions with remote and face-to-face achieved additional 1.30 kg and 1.56 kg average weight loss with the estimated average incremental costs of £23 and -£36 over the 12-month study, respectively. Slightly higher proportion of remote support group maintained at least 5 % weight loss from baseline (32.4 %) than in the face-to-face support group (29.2 %).

A recent Finnish studies revealed that travel costs related to screening of type 2 diabetes patients constitute a substantial cost item, the consideration of which in healthcare planning would enable the societal cost-efficiency of care to be improved [31] and travelling costs including also productivity-related costs can im-

impact the outcomes of cost-effectiveness analysis in multiple myeloma treatments [32]. These findings support, and are supported by, our finding that 12% to 16 % of HWH's PCF comes from travelling costs.

A key strength of present study was the Finnish RWD utilized. Finnish register data and electronic health records are of high quality and cover practically all individuals with unique social insurance code. Unfortunately, the characteristics and the affordability of Finnish health care complicates generalization of the previous findings from other countries to the Finnish setting. A number of guidelines, recommendations and reporting rationale are available for carrying out health economic evaluations and register studies in the efficient Finnish system (e.g. [13,17-19]). In addition, in the present cost-benefit evaluation we applied the PICOSTEPS principle [4,13,15], which has been previously successfully applied also in multiple other health economic evaluation tasks (e.g. [12,13,15,16,32]).

On the other hand, the key limitations of present analysis are mainly related to perspective and time. As mentioned above, the analytical perspective was limited to payer perspective and direct costs, in line with the Finnish recommendations [17,18]. Producer costs, such as development, staff training, production or maintenance costs related to CGC or HWH were not included, as these are assumed all to be covered by the price to payer.

In line with the payer perspective, indirect costs were not considered, although they can be a significant or even the most significant cost driver in analyses with wider perspectives [32,34]. Costs, such as time costs, sickness allowances, early retirement, absenteeism, re-education and unemployment due to obesity or associated comorbidities, would affect an analysis with wider societal perspective, and should be included in when evaluating the full societal effects of an intervention or disease. The direct cost perspective is likely to be conservative for HWH, as HWH resulted to less use of resources and would likely also result to lower indirect costs than CGC. For instance, time costs or costs of work absenteeism related to physical health care visits or travelling were not considered in the analyses, thus

at least partially underestimating the full benefit of web-based intervention.

In addition to indirect costs, analysis also excluded direct costs related to primary and social care, as well as secondary care beyond the 5-year time horizon. Although, among unselected Finnish primary care patients, primary care costs constitute a significant proportion of total health care costs [33], we did not have data regarding the primary or social care resource use or costs among patients treated for obesity in secondary care with CGC or HWH to support any assumption on how HWH would impact direct primary or social care costs. While that could be the case if, for instance, HWH is more effective than CGC, we conservatively assumed that HWH has no impact on primary care or social care costs. Less effective intervention would likely to be associated with higher direct long-term secondary care, primary care and social care costs, due to comorbidities associated with untreated obesity.

Although effectiveness, cost-effectiveness or cost-utility were not in the focus and could not be assessed in the present study based on the data available, the analyses still are conservative for HWH. Namely, the HWH is not expected to be less effective than the CGC at population level, nor are the results likely to get worse for HWH in a longer-term analysis covering also obesity-associated conditions and mortality. This assumption seems credible, given that in a recent Finnish randomized trial the examined web-based health behavior support produced larger average weight loss maintained up to 24 months than the examined face-to-face cognitive behavioral therapy alone in the Finnish setting [18]. The study also demonstrated that the greatest weight loss was achieved, when web-based support was given in addition to cognitive behavioral therapy. Thus, HWH may produce better results than achievable by simpler web-based interventions without interactive coaching, because virtual coaching is an integral part of HWH. Unfortunately, large body of previous studies examining the effectiveness of various different web-based interventions in different settings [5-11] are not comparable to HWH, nor transferable to the Finnish setting, and thus cannot be used to draw conclusions on the effectiveness of HWH.

However, HWH has a great potential for future studies and assessments, as participant data is collected up to 5 years on weight, service use and other important indicators such as lifestyle, motivations, body image, physical exercise, nutrition, medication, morbidity, perceived health, self-perceptions, psychological factors and sleep. Effects of HWH on weight management, health and quality of life of patients with obesity will be studied and reported in the future. Moreover, the future research aims also include assessing the factors predicting long-term success in the weight management, predicting the long-term health outcomes achievable with HWH and estimating how cost-effective HWH could be when considering also the long-term outcomes, such as prevention of diabetes and cardiovascular diseases. An analysis using wider societal perspective and life-time horizon covering costs related to long-term effectiveness would provide more comprehensive view on the full potential impacts of HWH in treatment of obesity.

Conclusion

HWH is a more affordable alternative to CGC, can potentially be cost-saving, free capacity and allow more efficient use of resources targeted at combating the increasing obesity epidemic. HWH could enable weight management for larger populations than previously possible from both technical and budgetary perspectives.

Conflict of interest

ESiOR Oy received financial support for the analysis from the Helsinki University Hospital District. SV and ES are employees of ESiOR Oy, Kuopio, Finland. ESiOR carries out studies, statistical analysis, consultancy, education, reporting and health economic evaluations for several pharmaceutical, food industry, diagnostics and device companies, hospitals, consultancies, academic institutions and projects, including also the producers and marketers of eHealth services. Neither SV nor ES received any direct financial support as individuals and declare no personal conflicts of interest. SA, LS or KPH declare no personal conflicts of interest.

Acknowledgements

The authors wish to thank Helsinki University Hospital (HUS) District for the support with the analysis preparation; Finnish Journal of eHealth and eWelfare for the invitation to write this article based on the eHealth2019 conference presentation; ESiOR Oy for the support with equipment and time for the article preparation; and Visa Honkanen from HUS for the support with project. HUS Abdominal Center is acknowledged for the development of the HealthyWeightHub (HWH).

KHP wishes to thank the Academy of Finland (272376, 266286, 314383), Finnish Medical Foundation, Finnish Diabetes Research Foundation, Novo Nordisk Foundation, Gyllenberg Foundation, Sigrid Juselius Foundation, Helsinki University Hospital Research Funds, Government Research Funds and University of Helsinki for their support. The funders had no role in planning study design, data collection, and analysis, decision to publish, or preparation of the article.

The authors wish to acknowledge following conference presentations:

Väätäinen S, Soini E, Arvonen S, Suojanen L, Pietiläinen K. Cost-benefit evaluation of digital HealthyWeightHub: Virtual Hospital 2.0. eHealth2019 – International Conference 2019 & The 24th Finnish National Conference on Telemedicine and eHealth “Data-Driven Health”, page 72.

Väätäinen S, Soini E, Arvonen S, Suojanen L, Pietiläinen K. Cost and capacity effects of HealthyWeightHub @ Virtual Hospital 2.0. Poster presentation (PDB48) in the Annual European International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Congress 2019, Copenhagen, Denmark.

Väätäinen S, Soini E, Arvonen S, Suojanen L, Pietiläinen K. Digitaalisen terveyslaitohdutusvalmennuksen vaikutukset lihavuuden hoidon kustannuksiin ja kapasiteettiin erikoissairaanhoidossa. Oral presentation in the National Conference of Effectiveness Research 2019, Kuopio, Finland.

The authors wish to acknowledge the following author contributions. Study: management (ES, SA), conceptualization (ES, SV, SA), design (all); data: acquisition (all), interpretation (all); analysis: design (SV, ES), implemen-

tation (SV, ES), interpretation (all); manuscript: initial drafting (SV, ES), critical revision (all), final approval (all).

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